REMARKS

Summary of Amendments

Paragraph [0038] in the specification before the examiner, (which is numbered "[0040]" in the published version), has been amended to correct the two instances in which the Greek letter *mu* (μ) before "m"—meant to indicate micron units following given numerical values—is garbled. These amendments amount to formal corrections only; of course no new matter has been added. The illegibility of "μ" would seem to be an artifact of the submission of the present application by means of the USPTO's Electronic Filing System. When Applicant's representative submitted the present application, versions of the specification printed out via browser display and via "ePAVE" (the USPTO's proprietary electronic submission software)—and currently still viewable—on Applicant's end contained no illegible text.

Claims 1 and 2 have been amended to delete the phrase "that would otherwise be," which is a mistranslation (or what is perhaps better described as an over-translation) from the Japanese original. (This phrase has been replaced simply with the word "being" in claim 1.) It is feared that the phrase "would otherwise be" could be mistaken to mean that the holes nearest (claim 1) or secondarily adjacent (claim 2) to the point defect also are missing.

That is, in terms of Fig. 1 of the present specification, and as explained in paragraph [0039] therein, the point defect 4 is where three of the through-holes 2 are missing, and at least one of the holes 2a, 2b, etc., represented by dashed lines, immediately surrounding the defect 4 is made to be a different size from the rest of the holes 2. But in claim 1, saying that these holes (low-refractive-index substances) 2a, 2b, etc. are holes that "would otherwise be" immediately surrounding the defect 4 is to mistakenly suggest that the holes 2a, 2b, etc. also are missing. This same concern applies *mutatis mutandis* to the technical import of what is set forth in claim 2 and described in the present specification in paragraph [0045] with regard to Fig. 8

Double Patenting

Claims 1-11 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-11 of Pre-Grant Pub. No. 2004/0165850 (co-pending Pat. App. No. 10/708,124).

Form PTO/SB/25, "Terminal Disclaimer to Obviate a Provisional Double Patenting Rejection over a Pending 'Reference' Application," completed in compliance with 37 C.F.R. § 1.321(c) and accompanied by the appropriate fee, is

attached to this paper. Accordingly, it is believed that the rejection under this section of the Office action is overcome.

Claim Rejections under 35 U.S.C. § 103

Claims 1-11; Akahane et al. (*Applied Physics Letters*) in view of Srinivasan and Painter (*Optics Express*)

Claims 1-11 have been rejected as being obvious over Akahane et al., "Design of a channel drop filter by using a donor-type cavity with high-quality factor in a two-dimensional photonic crystal slab," *Applied Physics Letters*, Vol. 82, No. 9, March 3, 2003, pp. 1341-1343 (simply "Akahane" hereinafter), in view of Srinivasan and Painter, "Momentum space design of high-Q photonic crystal optical cavities," *Optics Express*, Vol. 10, No. 15, July 29, 2002, pp. 670-684 (simply "Srinivasan" hereinafter).

Regarding claim 1, the Office action acknowledges that Akahane does not teach one of the low-refractive-index substances nearest the point defect being dimensionally altered from the predetermined dimension. The action then notes, "Srinivasan teaches that the geometry of a point defect and the surrounding holes in a two-dimensional photonic crystal can be altered in order to revue the vertical radiation loss from the photonic crystal slab." The Office action concludes that this would motivate a person skilled in the art to apply the teachings of Srinivasan to the teachings of Akahane.

One of the two passages in Srinivasan that the Examiner cites—i.e., page 673, section 3, line 3—states, "the geometry of the defect and the surrounding holes can be tailored to reduce the magnitude of these [small in-plane momentum] components [that characterize vertical radiation loss]," mentioning that this was done by J. Vučković et al. in "Design of photonic crystal microcavities for cavity QED," (Phys. Rev. E 65, 2002).

Yet what is meant by "point defect" in Srinivasan must be considered. (What is meant by this term in Vučković et al. can be considered by reviewing the article, available at **http://people.deas.harvard.edu/~loncar/papers/PRE_cavities.pdf**.)

In Srinivasan, (and in Vučković et al. as well), point defects in any given photonic crystal lattice arrangement involve modifications of either a single hole, or a pair of holes about a common center. Srinivasan teaches modifying defect geometry in three specific ways: (1) as illustrated in the left-most column of Table 6 on page 679; (2) as illustrated in the left-most column of Table 7 on page 680; and (3) as illustrated in Fig. 7(a) on page 682. In the first instance, the defect geometry is designed by enlarging the radius of the single hole constituting the defect. In the

second, each of the pair of defect-constituting holes about common center *e* is reduced in diameter. While in the first two examples, the geometry of the lattice holes surrounding the point defect is unaltered, in the third example—a modification of the second—holes neighboring the defect are altered to created a "graded lattice." Specifically, the immediate-neighbor holes are enlarged in radius, and "[t]he hole radii are then increased parabolically outwards for 5 periods in the $\hat{x}$ direction and 7 periods in the $\hat{y}$ direction, after which they are held constant."

Thus, the point defect geometry taught by Srinivasan in every instance alters the diameter of the hole or pair of holes constituting the defect. In contrast, a point defect as recited in claim 1 according to the present invention contains a plurality of three or more lattice points where holes or hole-analogues—formed by low-refractive-index substances having a small refractive index relative to the slab—of predetermined identical dimension and shape are missing from the lattice arrangement.

The formative structure of a point defect according to the present invention is as Akahane describes. Thus, "said low-refractive-index substances are missing from said arrangement" means, as Akahane says in the second and third lines of the third paragraph in the right-hand column on the first page, "donor defects . . . [that] are filled with the same dielectric substance as the slab." Such a formation may be by, as recited in claim 6 of the present application, "[filling] said low-refractive-index substances . . . into columns perforating said slab."

For the record, it is noted that Yoshihiro Akahane, Takashi Asano, and Susumu Noda, the three inventors in the present application, are among the five coauthors of the article from *Applied Physics Letters* cited in making the present rejection, and submitted by the present Applicants in the IDS filed June 14, 2004 in the instant case. Thus, it is a given that Applicants acknowledge the teachings in Akahane that are relevant to claim 1.

Nevertheless, it is respectfully submitted that no *prima facie* showing has been made of what in Srinivasan might teach or suggest applying any of the principles discussed in Srinivasan to the special configuration of a donor-type defect as recited in claim 1. Srinivasan is silent as to point defects of a configuration according to the present invention. Consequently Srinivasan would not motivate a person skilled in the art to turn to Akahane for a completely different approach to point defect configuration, and modify the defect-surrounding geometry as set forth in the present specification and recited in the present claims.

In fact, Srinivasan would seem to teach away from the combination proposed in the present Office action in rejecting claims 1-11: In the paragraph on page 684 just before section 6, Summary, Srinivasan states,

> "Changes may also be made to improve other aspects of the design. In particular, . . . reducing the complexity of the design (in terms of the number and size of holes comprising the defect) may be of interest from a fabrication standpoint."

This would seem to discourage pursuing the design of a point defect geometry involving more than two holes on neighboring lattice-points. In the next sentence, Srinivasan mentions, "The approach to such designs can be aided through the Fourier space consideration of the dielectric perturbation as has been described in this section." Perhaps the very complexity of that analysis even on a point defect comprising two holes deters applying the same analysis to a defect comprising a plurality of three or more.

It believed that the foregoing has clearly set forth that Srinivasan never addresses defect geometries as set forth in claim 1. Without exception, the point defect geometries taught by Srinivasan involve altering the configuration of the point-defect-constituting hole or pair of holes. In the present invention in contrast,

> said point defect contains among said lattice points a plurality of three or more neighboring one another, and in said plurality of three or more lattice points said low-refractive-index substances are missing from said arrangement

and the low-refractive-index substances are "of predetermined identical dimension and shape." It is respectfully submitted that a Fourier space consideration of the filled holes in a defect according to the present invention would have to treat the holes in the defect as identical to those of the rest of the lattice, except for those immediately surrounding and secondarily adjacent whose geometry is modified according to the present invention.

In sum, the combining of the teachings of Srinivasan and Akahane to reject the present claims benefits from the hindsight imparted by the present specification. The present inventors, coauthors of the *Applied Physics Letters* paper, may have been motivated to combine their discoveries with teachings of Srinivasan, and for example Vučković et al., but rather than disclose that motivation—and the present invention—in their paper, they chose to present the present application in exchange for rights to a patent on their idea. While the *Graham* factual inquiries are background for determining obviousness, against that background, a *prima facie* motivation to combine must be, but in the present Office action has not been, shown.

It is respectfully submitted that for the foregoing reasons the patentability of the present application rests in claim 1 to begin with, and that the present reply is fully responsive to the separate rejections of claims 2 through 11, in that claims 2 through 11 should be held allowable as depending directly or indirectly from claim 1.

Accordingly, Applicant courteously urges that this application is in condition for allowance. Reconsideration and withdrawal of the rejections is requested. Favorable action by the Examiner at an early date is solicited.

Respectfully submitted,

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